CORE CURRICULUM COMPONENT APPLICATION
Sam Houston State University

Revised October, 2012

PART I – Course Information

Course Type
☒ Existing/Restructured
☐ New Course Proposed Fall 2013
If new, have you submitted a Form B to the SHSU Curriculum Committee? ☐ Yes ☐ No

Course Prefix & Number: MATH 1410

Texas Common Course Number (TCCN Matrix): MATH 2412

Course Title: Elementary Functions

Course Catalog Description (Copy and paste from online catalog for existing courses): Elementary Functions and their applications, including topics from algebra, trigonometry and analytic geometry, are used to assist in the algebraic and graphical description of the following elementary functions: polynomial, rational, exponential, logarithmic, and trigonometric functions.

Course Prerequisites: THEA score of 270 or permission of instruction.

Available Online?
☐ Yes, currently developed in online delivery mode
☐ Anticipated development in online delivery mode (Semester, Year:)
☒ No

Number of Sections to be Offered per Academic Year: 10

Estimated Enrollment per Section: 40

Course Level (freshman, sophomore): freshman

Designated Contact Person (for follow-up communication purposes): Dr. Rebecca Garcia

E-Mail Address: rgarcia@shsu.edu

Phone: 936-294-3520

Approvals

Department Chair:	Signature	Date: 10-18-12
Academic Dean:	Signature	Date: 10/22/12

Submit completed, signed form to Core Curriculum Committee - Box 2478 or Fax 4-1271

PART II – THECB Foundational Component Areas

See Appendix for full description of each component area.

Select Component Area: II. Mathematics

In one paragraph, describe how the proposed course will fulfill the core and skill objectives of the component area:

Elementary functions is the study of polynomial, exponential, logarithmic and trigonometric functions and their properties. In particular, students completing this course will be able to define each function in general, state properties of each (such as their domain and range), combine functions via arithmetic operations and composition, and provide examples of applications in which they are used. Implicitly, students successfully completing this course will (1) refine their understanding of key mathematical concepts such as functions and their general properties, (2) be familiar enough with these properties in order to use the functions in later courses such as calculus, and (3) learn to apply these mathematical concepts in appropriate settings.

PART III – Course Objectives & Student Learning Outcomes (SLO)

Insert the applicable course objectives stated as student learning outcomes (e.g., Students completing the course will be able to...) that support the core component area objectives. Please reference the component rubric for additional information on core component area objectives.

Objective/SLO 1:

Students successfully completing this course will gain a greater understanding of the use of elementary functions in describing natural and physical arrangements; refine pattern recognition skills via graphing these functions and verification and/or proof of identities; and reformulate real world problems into accurate mathematical expressions that can be solved. In so doing, students will have increased quantitative literacy in the logic of describing geometric arrangements using trigonometric, algebraic, exponential, and logarithmic functions, the patterns within the properties of these functions, and the relationships among these functions.

How will the objective be addressed (including strategies and techniques)?

Students will be exposed to the relationship between the definitions and properties of the six basic trigonometric functions; polynomial and rational functions; and exponential and logarithmic functions and relate these properties to their graphical representation. In particular, students will be able to translate between the definition and graph of a modified elementary function. In addition, students will be able to relate certain properties of each of these functions to the other

functions. For example, students will derive the double-angle and sum-to-product formulas of all six basic trigonometric functions. Students will be able to write a valid equation using the trigonometric functions given either the arrangement of vectors in the plane or the measurements of the angles and lengths of sides of a given triangle.

In addition, students will be able to recognize an exponential function from its graph and provide its functional definition. In addition, students will be able to relate certain properties of each of these functions to the other functions. For example, students will be able to determine which logarithmic function is the inverse of a given exponential function.

Describe how the objective will be assessed:

This objective will be assessed through embedded problems in quizzes, exams, and/or in-class worksheets. Instructors will incorporate a common subset of problem types in one of the exams of each section. As an example, instructors may include a question that requires the student to determine whether a given function is invertible, and if so provide the inverse. Or instructors may include a question that requires the student to prove one of the basic trigonometric identities, solve a triangle with more than one (or no) solution, or provide a sketch of the graph of a given trigonometric function that has been modified from its basic form.

Objective/SLO 2:

Students successfully completing this course will be able to state fully the definitions, properties, and uses of general polynomial, rational, exponential, logarithmic, and trigonometric functions. Emphasis will be placed on accurately representing given mathematical information both symbolically and graphically, with attention given to determining the domains and ranges of these functions, translating between the graphical form of a function and its definition, and expressing the trigonometric relationship among graphically presented items in written form. In so doing, students will gain a greater understanding of key mathematical concepts.

How will the objective be addressed (including strategies and techniques)?

In order to fully comprehend the importance and uses of these functions, their definitions must be fully understood, in particular their domains and ranges. Simply being able to compute function values on a calculator will not provide the skills necessary to use these functions properly in calculus, much less correctly apply them when solving problems. All students will therefore be able to identify the domain, range, graph, and other fundamental properties of each of these functions.

In addition, simply memorizing the function values of trigonometric functions (on the unit circle, for example) does not provide the skills necessary to use these functions properly in calculus, much less correctly apply them when solving problems. All students will therefore be able to identify the domain, range, graph, and other fundamental properties of each of these functions.

In addition, the key uses of these elementary functions will be more fully understood after students are able to express information that is presented graphically or verbally as an equation involving these functions. That is, students will be able to sketch the graph of a given trigonometric function or be able to describe that trigonometric function whose graph most closely matches one that is given.

In addition, students will be able to turn a diagram or a set of sentences containing both known and unknown quantities into an algebraic and/or trigonometric equation that adequately captures the information required to determine those unknown quantities.

Describe how the objective will be assessed:

This objective will be assessed through embedded problems in quizzes, exams and/or in-class worksheets. Instructors will incorporate a common subset of problem types in one of the exams of each section. As an example, instructors may be asked to include a question that requires students to sketch the graph of a rational function that has a horizontal asymptote and more than one vertical asymptote. Students may also be asked to translate information presented pictorially (e.g., the shadow of a tall object) as a trigonometric equation.

Objective/SLO 3:

Students successfully completing this course will use appropriate technology to enhance mathematical thinking and understanding, solve problems using mathematical concepts, and judge the level of reasonability of the results. Students will learn to interpret mathematical formulas, graphs and tables and will expand their mathematical reasoning skills to develop sound mathematical arguments.

How will the objective be addressed (including strategies and techniques)?

Applications are an important part of understanding the key concepts of elementary functions. In particular, the applications have implicit conditions wherein these concepts make sense (e.g., a nonnegative distances, or production quantities within a particular range of values). Significant time will be spent on developing principle ideas arising from physics, economics, and biology; specifically how the properties of these elementary functions are applied to further understanding these applications.

This course will prepare students for the rigor of differential calculus, with applications often chosen to lessen the level of anxiety typically encountered in calculus. For example, trigonometric and geometric identities will be used to develop the formula for the volume of a general circular cone in anticipation of the classic problem of determining the rate of change of the height of a cone formed from dropping sand from a conveyer belt.

Describe how the objective will be assessed:

This objective will be assessed through embedded problems in quizzes, exams and/or in-class worksheets. Instructors will incorporate a common subset of problem types in one of the exams of each section. As an example, instructors may include a question that requires the student to to use the principle of exponential growth to compute the amount of bacteria present at a particular time given the amounts of bacteria that are present at two distinct points in time. Or perhaps instructors may include a question that requires the student to determine the area of the sector defined by a given angle within a circle with a given radius.

Objective/SLO 4:

How will the objective be addressed (including strategies and techniques)?

Describe how the objective will be assessed:

Objective/SLO 5:

How will the objective be addressed (including strategies and techniques)?

Describe how the objective will be assessed:

PART IV – THECB Skill Objectives

Address each of the THECB skill objectives required within the component area. Explain how the skill is addressed, including specific strategies to address the skill(s). *Address ALL skill objectives associated with the selected Component Area. (See Appendix)*

1. Critical Thinking Skills: to include creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information

How will the skill be addressed (including specific strategies, activities, and techniques)?

The concept of a mathematical function is one of the most fundamental non-numeric objects in mathematics. Understanding functions and their properties is essential to learning the language of mathematics and its uses. Algebraic (polynomial and rational) and transcendental (exponential and logarithmic) functions in particular are important to fields from economics to biological and computing sciences. The trigonometric functions form the development of the basic groundwork for metric geometry. Distance, angle measure, and congruence of triangles are all developed through trigonometry. A comprehensive understanding of the trigonometric concepts is necessary for success in calculus or any field requiring a quantitative understanding of spatial geometry, e.g. industrial technology.

Students completing this course will know the definitions, domains and ranges of the general forms of elementary functions. Properties such as periodicity, asymptotes, boundedness and numbers of roots will be discussed at length, allowing students to relate the shapes of the graphs to the uses of each of these functions. As a direct result, students will to be able to determine which of these functions are more appropriate as a model for a given physical, biological, or economic model. For example, students will know that the decreasing exponential function with its horizontal asymptote is the best function to use as a model for radioactive decay.

In addition, the ability to convert information presented graphically or pictorially (such as the arrangement of vectors in space or the directions of moving objects) to a mathematical equation will invariably require an understanding of trigonometry. Being able to define those trigonometric functions and understand their properties is fundamental to this process.

In order to solve equations involving these functions, it will be necessary for students will learn the operation of composition of functions, be able to determine which functions are invertible, and be able to compute the inverse of those functions deemed invertible. Students will consequently be able to compute break-even points in business analysis, determine the half-life of radioactive elements, and compute equilibrium prices of economic models, among many other applications.

2. Communication Skills: to include effective development, interpretation and expression of ideas through written, oral and visual communication

How will the skill be addressed (including specific strategies, activities, and techniques)?

Students will develop their written, oral and visual communication skills as a natural part of the learning process. Obtaining a true understanding of elementary functions requires each students works closely with graphical representations of mathematical functions and using such visual representations to communicate information about the function and its behavior through writing and speech. Students are routinely asked to explore and explain a variety of concepts and applications in writing exercises that challenge students to discuss important functional concepts with precision. In addition, many of the exercises task the student with translating plain language into symbolic mathematical expressions, resolving the problems algebraically, and communicating the results in plain language, either verbally or written.

Improving communication skills could be addressed in one of two ways, either in the form of class presentations or within group work. In those classrooms which implement student presentations, students will be expected to present solutions to several problems to the rest of the class on a regular basis. Solutions will be presented in both written form (on the board, in front of the room) and orally (explaining methods used and conclusions drawn). Students presenting solutions will receive immediate feedback from those students listening to the presentation.

Those classrooms not having students present their work to their classmates will use group work to address communication skills. On a regular basis (such as during weekly quizzes) the class will be partitioned into small groups of three or four students, and each group will work on either a lengthy problem or on a sequence of problems to be solved using trigonometry. The groups will either be assigned by the instructor or formed by the students. Typically each student turns in her own set of solutions, requiring communication among group members, ensuring complete, correct solutions.

3. Empirical and Quantitative Skills: to include the manipulation and analysis of numerical data or observable facts resulting in informed conclusions

How will the skill be addressed (including specific strategies, activities, and techniques)?

Students completing this course will be able to transform observable or measurable data into a mathematical model that can be used to represent the process or phenomenon from which the data was produced. Students will use the earlier mentioned critical thinking skills to ascertain which type of model is best (polynomial or exponential, for example), then use the available data to determine the relevant parameters needed for the particular function.

For example, given the size of a population at two distinct moments in time, students will be able to compute the two parameters needed for a general exponential population model. Or

given the fixed and marginal costs required to produce one particular item, students will be able to determine the quadratic function that provides the total cost of producing any number of these items.

The manipulation of the trigonometric functions is a skill necessary for success in a later calculus course. Students will be able to use the double angle identities to simplfy or expand a trigonometric function in terms of other trigonometric functions. Studnets will be able to use the pythagorean identites to write a product of secant and tangent functions in terms of only tangent functions, to mention one example. Establishing such familiarity with the relationships between these elementary functions allow students to manipulate these quantities in order to be used in the settings of differential and integral calculus.

4. Teamwork: to include the ability to consider different points of view and to work effectively with others to support a shared purpose or goal

How will the skill be addressed (including specific strategies, activities, and techniques)?
This skill will not be addressed.

5. Personal Responsibility: to include the ability to connect choices, actions and consequences to ethical decision-making

How will the skill be addressed (including specific strategies, activities, and techniques)?
This skill will not be addressed.

6. Social Responsibility: to include intercultural competence, knowledge of civic responsibility, and the ability to engage effectively in regional, national, and global communities

How will the skill be addressed (including specific strategies, activities, and techniques)?
This skill will not be addressed.

PART V – SHSU Core Curriculum Committee Requirements

1. Using a 15-week class schedule, identify the topics to be covered during each week of the semester. Provide sufficient detail to allow readers to understand the scope and sequence of topics covered.

Week 1	Function notation, definition, evaluation. Function composition.
Week 2	One-to-one and onto functions. Inverse functions.
Week 3	Graphs of functions. Translations, shifts, streches fo functions. Use of graphing calculators to understand the "shape" of a function.
Week 4	Elementary functions: polynomial and rational functions.
Week 5	Solutions to polynomial equations.
Week 6	Zeros and asymptotes of rational functions.
Week 7	Elementary functions: exponential and logarithmic functions.
Week 8	Analytic properties of exponential functions
Week 9	The logarithm as an inverse function and its properties
Week 10	Applications of the exponential and logarithmic functions
Week 11	Elementary functions: the trigonometric functions
Week 12	Properties of the trigonometric functions
Week 13	Solving trigonometric equations; trigonometric identities
Week 14	Inverse trigonometric functions
Week 15	Polar coordinates and complex numbers

2. Attachments (Syllabus Required)

Syllabus Attached? ☒ Yes ☐ No

Other Attached? ☐ Yes ☒ No If yes, specify:

Appendix: THECB Component Area Descriptions and Skill Requirements

I. Communication (Courses in this category focus on developing ideas and expressing them clearly, considering the effect of the message, fostering understanding, and building the skills needed to communicate persuasively. Courses involve the command of oral, aural, written, and visual literacy skills that enable people to exchange messages appropriate to the subject, occasion, and audience.)

II. Mathematics (Courses in this category focus on quantitative literacy in logic, patterns, and relationships. Courses involve the understanding of key mathematical concepts and the application of appropriate quantitative tools to everyday experience.)

III. Life and Physical Sciences (Courses in this category focus on describing, explaining, and predicting natural phenomena using the scientific method. Courses involve the understanding of interactions among natural phenomena and the implications of scientific principles on the physical world and on human experiences.)

IV. Language, Philosophy, and Culture (Courses in this category focus on how ideas, values, beliefs, and other aspects of culture express and affect human experience. Courses involve the exploration of ideas that foster aesthetic and intellectual creation in order to understand the human condition across cultures.)

V. Creative Arts (Courses in this category focus on the appreciation and analysis of creative artifacts and works of the human imagination. Courses involve the synthesis and interpretation of artistic expression and enable critical, creative, and innovative communication about works of art.)

VI. American History (Courses in this category focus on the consideration of past events and ideas relative to the United States, with the option of including Texas History for a portion of this component area. Courses involve the interaction among individuals, communities, states, the nation, and the world, considering how these interactions have contributed to the development of the United States and its global role.)

VII. Government/ Political Science (Courses in this category focus on consideration of the Constitution of the United States and the constitutions of the states, with special emphasis on that of Texas. Courses involve the analysis of governmental institutions, political behavior, civic engagement, and their political and philosophical foundations.)

VIII. Social and Behavioral Sciences (Courses in this category focus on the application of empirical and scientific methods that contribute to the understanding of what makes us human.
Courses involve the exploration of behavior and interactions among individuals, groups, institutions, and events, examining their impact on the individual, society, and culture.)

Required Skill Objectives

Foundational Component Areas	Skill Objectives					
	Critical Thinking	Communication	Empirical & Quantitative	Team Work	Social Responsibility	Personal Responsibility
Communication	✓	✓		✓		✓
Mathematics	✓	✓	✓			
Life and Physical Sciences	✓	✓	✓	✓		
Language, Philosophy & Culture	✓	✓			✓	✓
Creative Arts	✓	✓		✓	✓	
American History	✓	✓			✓	✓
Government/Political Science	✓	✓			✓	✓
Social and Behavioral Sciences	✓	✓	✓		✓	

Submit completed, signed form to Core Curriculum Committee - Box 2478 or Fax 4-1271

Class Syllabus
MTH 1410, Elementary Functions
Fall 2014, Sam Houston State University

1. An important course!

The concepts of calculus created modern science and revolutionized the world! Calculus is fundamental to modern science and it, in turn, is founded on *a solid understanding of elementary functions*. "Elementary functions" are the functions which occur in most of calculus and basic math applications. They include polynomial functions, rational functions, trigonometric functions, exponential functions and their inverse functions, including the inverse trig functions and logarithms, along with functions created by composing a sequence of elementary functions. Almost every function appearing in scientific or economic applications is an elementary function.

In this course we will focus on understanding these functions and successfully manipulating these functions, in preparation for a successful transition into calculus.

2. Success in Calculus

This course has one objective -- to prepare the student for success in calculus. At many universities, less than half of the students in a calculus class get a C or better. Sadly, this is true at Sam Houston (at this time.) Most students in the first calculus course do not have the prerequisite understanding of elementary functions and so end up taking the calculus course several times. With this new class, MATH 1410, *Elementary Functions*, we hope to change that. Students in this class should plan on making an A or a B in this class and then moving on in the following semester to MATH 1420, Calculus 1, and continuing to be successful, with A or B grades!

Course objectives:
Students completing this course will be able to:

1. Use function notation and recognize functions as a fundamental mathematical concept.
2. Work with composition of functions.
3. Identify one-to-one and onto functions and compute the inverse of a function.
4. Use graphing calculators to understand the "shape" of a function.
5. Solve equations involving polynomial and rational functions.
6. Solve equations involving exponential and logarithmic functions.
7. Work with elementary functions on the unit circle to solve equations involving trig functions.
8. Work with inverse trigonometric functions.

More broadly speaking, the following objectives will be met:

- Students successfully completing this course will gain a greater understanding of the use of elementary functions in describing natural and physical arrangements; refine pattern recognition skills via graphing these functions and verification and/or proof of identities; and reformulate real world problems into accurate mathematical expressions that can be solved. In so doing, students will have increased quantitative literacy in the logic of describing geometric arrangements using trigonometric, algebraic, exponential, and logarithmic functions, the patterns within the properties of these functions, and the relationships among these functions.

- Students successfully completing this course will be able to state fully the definitions, properties, and uses of general polynomial, rational, exponential, logarithmic, and trigonometric functions. Emphasis will be placed on accurately representing given mathematical information both symbolically and graphically, with attention given to determining the domains and ranges of these functions, translating between the graphical form of a function and its definition, and expressing the trigonometric relationship among graphically presented items in written form. In so doing, students will gain a greater understanding of key mathematical concepts.

- Students successfully completing this course will use appropriate technology to enhance mathematical thinking and understanding, solve problems using mathematical concepts, and judge the level of reasonability of the results. Students will learn to interpret mathematical formulas, graphs and tables and will expand their mathematical reasoning skills to develop sound mathematical arguments.

Here are details about the mechanics of this course.
Textbook: *Precalculus* (A Unit Circle Approach), by Ratti & McWaters, first edition, 2009.
We will cover the following sections:

1.3-1.7 (functions, function composition, transformations, inverse functions)
2.1-2.6 (quadratics, polynomials, rational functions, proportional variation)
3.1-3.5 (exponential functions and logarithms)
4.1-4.6 (trig functions -- with heavy emphasis on the unit circle!)
5.1-5.5 (analytic trig, trig equations)
6.1-6.3, 6.6, 6.7 (applications of trig, including polar coordinates and complex numbers)

We will use Blackboard. Daily materials will be posted on Blackboard, along with class announcements. Students should check Blackboard and their email daily.

Prerequisites: a Math THEA score of 270 or the equivalent. Students entering this course should be comfortable with elementary algebra and intermediate algebra, function notation, linear equations, and factoring quadratic equations.

Contact information: My e-mail address is KenWSmith@shsu.edu. Please feel free to contact me by email. My office is LDB 421E. My office phone is 936-294-4869; if you call that number, please leave voice mail. My formal office hours are **immediately after class (*most days*) MWF 2-3 PM.**

3. Exercises and Assignments

There will be **daily reading expectations**, along with **daily online exercises** to work. The online homework is called MyMathLab (MML) and should be purchased with the book. Additional homework material will be posted on Blackboard in the form of worksheets. Students should print the worksheets and bring this homework to class (along with the textbook.)

We will have *three* forms of daily work. There is online MML homework. This homework will eventually be worth (in total) an exam grade, but -- more importantly -- this material *must* be completed successfully on a daily basis. To emphasize this, *a minimum grade of 70% on MML is required prior to taking each exam and prior to taking certain quizzes.*

In addition to routine MyMathLab exercises, there are worksheets and quizzes. There is a worksheet due every class day and there will be a quiz every class day. (Students must attend the entire class period if they wish to receive credit on the accompanying daily work.)

There are no make-ups on daily work for any reason but at the end of the term there will be extra daily grades, treated as extra-credit. These grades will allow a student to make up earlier poor performances or, possibly, a sick day.

A student who is ill or has some other significant emergency preventing the taking of an exam must contact the instructor as quickly as possible (usually this is *before* the exam) and then should provide documentation of the emergency. If it is decided that a make-up exam will be given, it will be scheduled for 7 AM on Friday, December 7, 2012 (the last class day.)

Attendance expectations (and a "professional commitment" to the class)

Attendance in any mathematics class is critical for success. Please treat this class as you would any professional commitment. (If you were to miss a day of work, you would contact your employer before your work day begins; if you must miss class, you should, in the same manner, contact your professor.) If you miss a class, please contact Dr. Smith *as quickly as possible*, preferably by sending email to KenWSmith@shsu.edu.

A student who misses three class days and who does not follow the "professional commitment" steps above will have their semester grade lowered one letter. Except for extreme cases of a serious emergency, a student who misses three class days will be presumed to have dropped the class; future material will not be graded.

Calculators

Calculators can be a great aid to mathematical computations but they can also act like a "magic wand", providing answers without understanding. In this course we will emphasize the *understanding* of mathematical concepts in place of "magic", so the use of these "magical wands" may be restricted. Calculators may be used on most homework and some quizzes. But many quizzes and exam problems will *not* allow calculators. Students should *not* use a calculator with a computer algebra system (CAS).

Collaboration & Plagiarism

On homework, or take-home quizzes, it is acceptable to receive tutoring from the instructor. Students are also *encouraged* to discuss the problems with other students. However, anything a student submits for grading must be in *their* own words, with *their* understanding of the material. To turn in material that is written in someone else's words or computations is *plagiarism.*

On in-class exams or quizzes, all the work a student turns in must be their own, without any aid from anyone else. Giving or receiving aid on in-class quizzes and exams will be considered *plagiarism* ("cheating.")

In this class, the penalties for plagiarism will include *at least* a zero grade on the submitted material and *most likely* a failing (F) grade in the course with a referral to a disciplinary committee. Further guidelines for classroom conduct (including absences on religious holy days) are available at http://www.shsu.edu/academics/syllabus-guidelines/ .

5. Grades

Grades are based on daily work (MyMathLab, quizzes and worksheets) and exams.

Daily work: MML: 100 pts. Worksheets and Quizzes: about 300 pts., depending on the course schedule.

Exams: Three regular exams: 300 pts. Final Exam: 200 pts.

Exams

There are three regular exams (100 points each) and a Final Exam (200 points). Prior to each exam, MyMathLab grades will be updated. In order to take an exam, this MML score must be **at least 70%.**

The following dates are tentative (and may be changed by announcements in class):

Exam 1 is on Friday, **Sept 28. Exam 2** is on Friday, **Oct 26** and **Exam 3** is on Monday, **Nov 19.** (70% grades in MML are required to take these exams.)

The **Final Exam** is on Monday, **Dec 10**, 2-4 PM.

Determination of semester grades

Grades are based on percentages, the ratio of total points to the total points of a fictitious student named *Perfect.* Perfect will score about 900 points during the semester, depending on the total number of worksheets and quizzes collected. A student who has met the professional obligations (explained above) and who achieves 90% or higher on the total points will receive an **A.** A student who meets the professional obligations and achieves at least 80% of the total points will receive at least a **B;** similarly 70% (and the professional commitment) gives at least a **C** grade. In order to receive a **D** grade, a student must achieve at least 62% of the total points.

A grade of **C** or better in this class is required to continue on to Calculus.

6. Writing

Mathematicians should write well. Please don't abbreviate (unless we have agreed on some common abbreviations). Please write with good grammar, in complete sentences. Spell correctly. Write so that others will find your work easy to read. Display your work in correct mathematical notation, with equal signs, appropriate symbols and function notation. (I will try to help you improve your math writing.)